Space Weather Technical Forecast

Issued on Sunday 24 November 2024 at 12:24 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate Solar Activity likely, slight chance of X-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with two low level M-flares, peaking M1.1 at 23/1607 UTC. There are now twelve active regions on the visible disc, with a new region developing between AR3901 and AR3907 and a further new region east of AR3900. The most notable regions are the two largest which are close together in the southeast. The magnetic complexity of these regions has been difficult to ascertain due to the viewing angle, but they are starting to approach an area where more detail is becoming apparent. Of the two, AR3906 looks the more complex, with a weak delta region becoming apparent north of the main leading spot. AR3905 is starting to show more weak intermediate spots. The remaining spots on the disc are relatively smaller and simpler, although both AR3901 and AR3907 show some minor magnetic complexity, both having beta-gamma classifications.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as measured by ACE at L1 were mostly at slightly elevated levels, perhaps under weak fast wind influence. Wind speeds mostly varied between 370-430 km/s, with density below average. The Interplanetary Magnetic Field, Bt, was weak to moderate, occasionally peaking around 8nT. The north-south component varied weakly between +/-7nT. Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels. The associated 24-hour fluence remained below Active, with 1.59e6 total pfu observed at 24/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with occasional M-flares likely and a slight chance of isolated X-class flares, primarily from from the regions in the southeast.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs forecast. The current slightly elevated wind speeds may become elevated at times early in the period due to negative coronal hole enhancement from CH94. However, any significant connection appears unlikely.

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Geomagnetic activity is expected to remain at Quiet to Unsettled (Kp 0-3) levels through the period, with a slight chance of Active (Kp 4) intervals through Days 1 and 2 (24-25 Nov).

Energetic Particles / Solar Radiation: High energy protons are expected to persist at background levels, with a slight but rising chance of enhancement, mainly from the regions in the southeast. High energy electron flux is expected to be mainly at background levels with the associated fluence remaining below the Active threshold.

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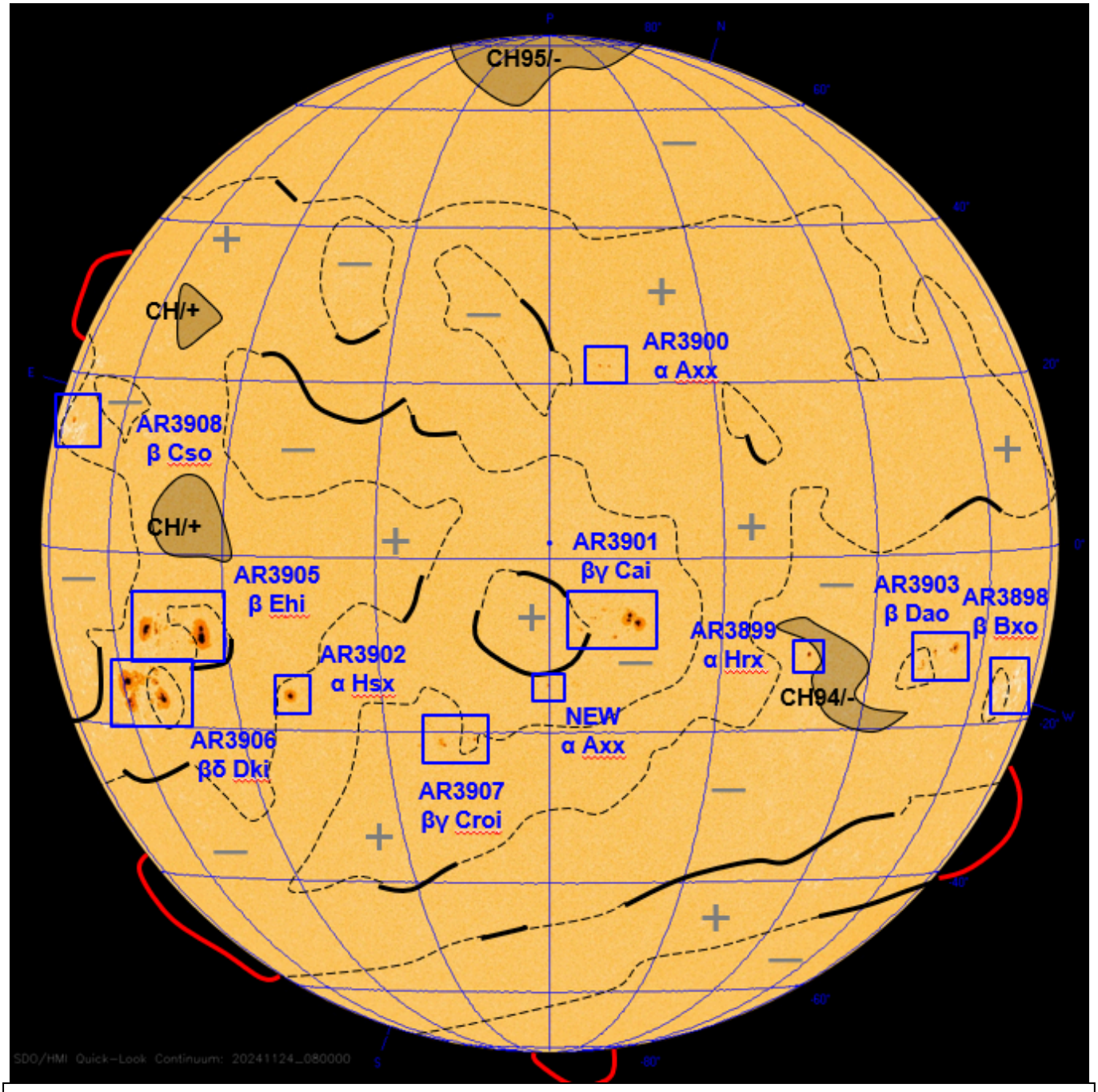
Figure 1: Solar synoptic map, valid 24/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs forecast at present.

The current slightly elevated wind speeds may become elevated at times early in the period due to negative coronal hole enhancement from CH94. However, any significant connection appears unlikely. No other recurrent or forecast enhancement is forecast at present with winds expected to ease to background levels during the period. MOSWOC Enlil model output continues to significantly over estimate solar wind speeds, and is considered likely to be too fast through the rest of this period.

Geomagnetic activity is expected to remain at Quiet to Unsettled (Kp 0-3) levels through the period, with a slight chance of Active (Kp 4) intervals through Days 1 and 2 (24-25 Nov).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2: MOSWOC Enlil, which is significantly over-estimating current wind speeds, reducing confidence in its forecast.

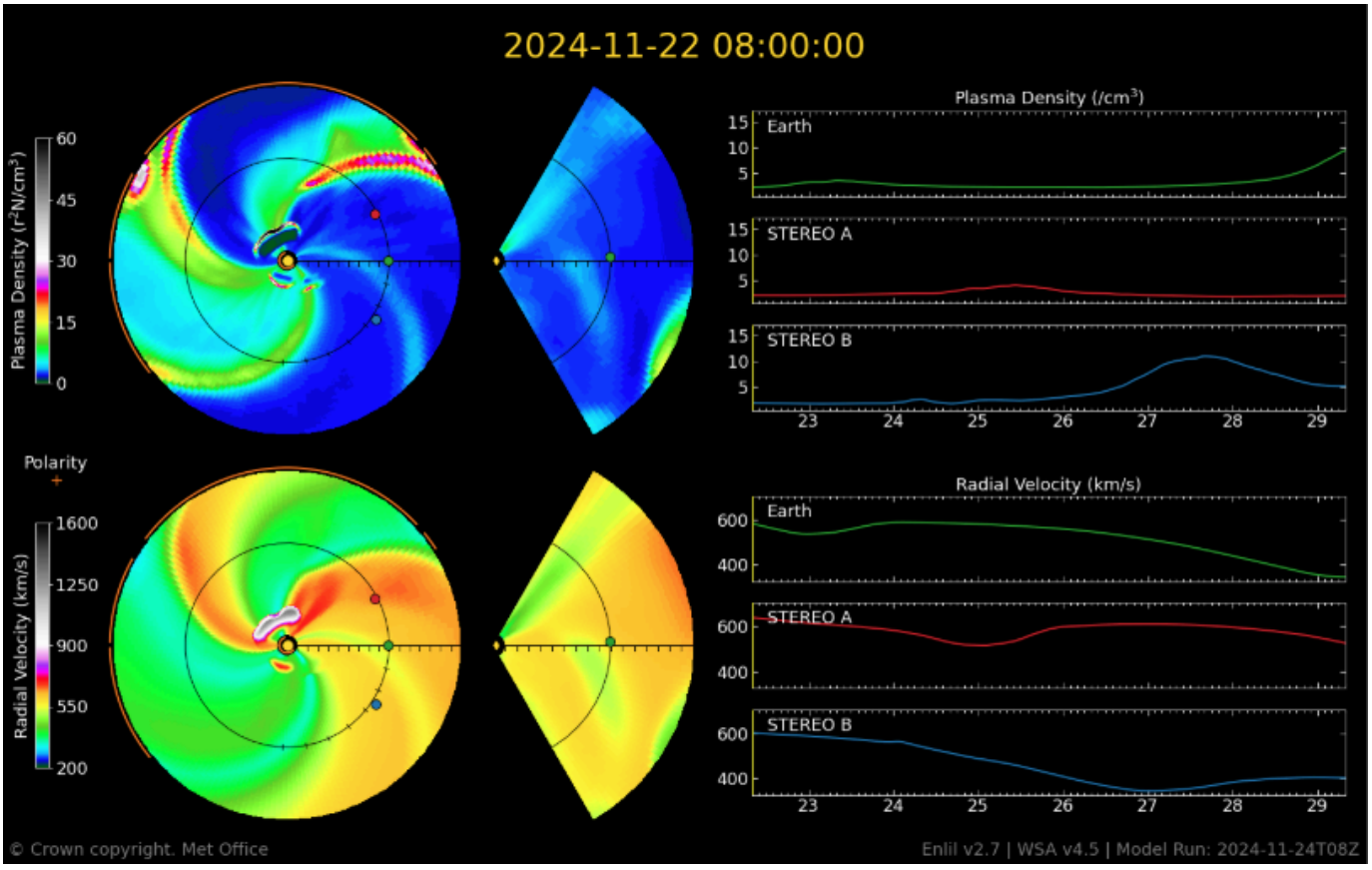

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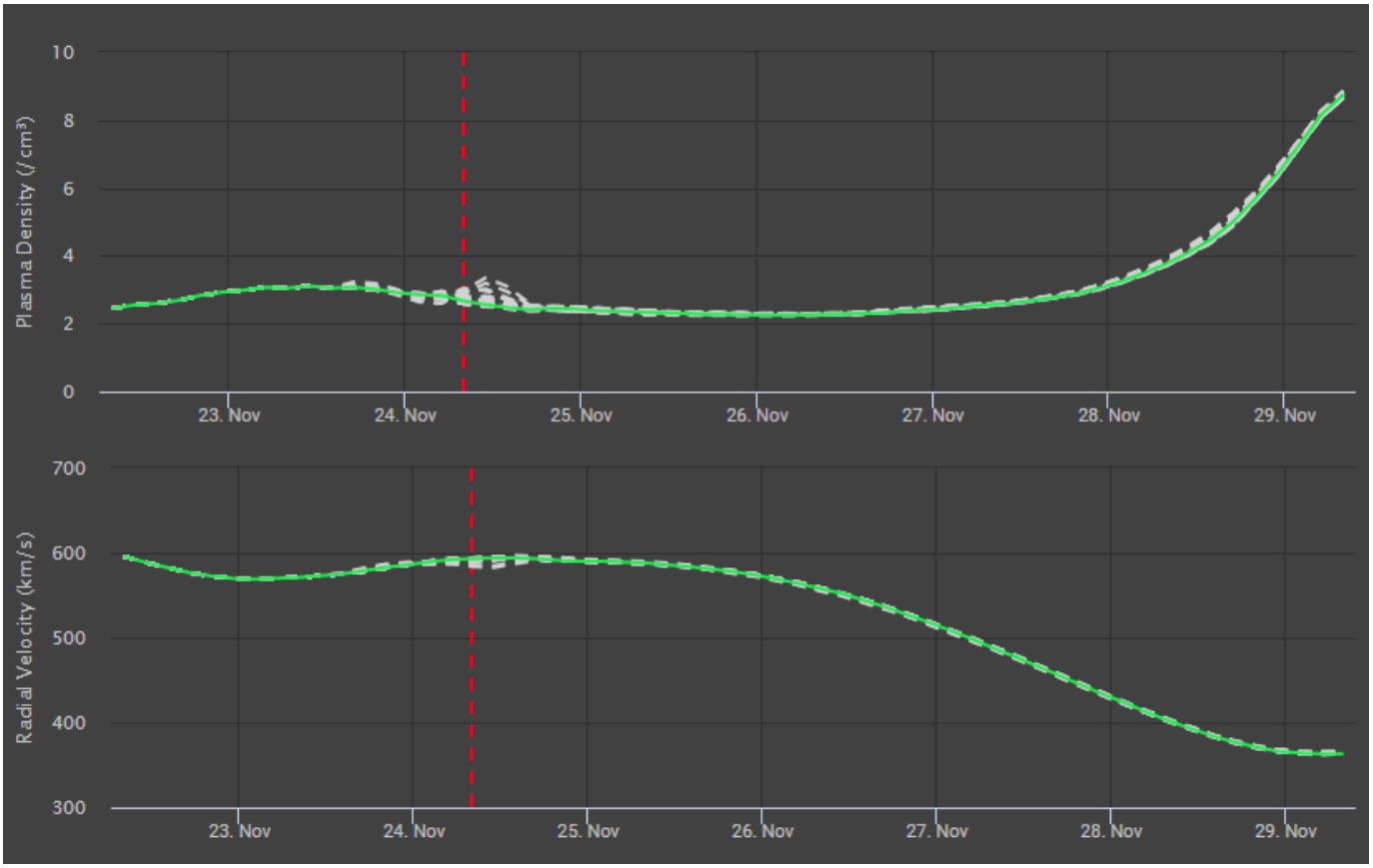
Figure 3: MOSWOC Enlil ensemble, with Earth directed CMEs considered unlikely.



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Radio Blackouts - X-Ray Flares

There are now twelve active regions on the visible disc, with a new region developing between AR3901 and AR3907 and a further new region east of AR3900. The most notable regions are the two largest which are close together in the southeast. The magnetic complexity of these regions has been difficult to ascertain due to the viewing angle, but they are starting to approach an area where more detail is becoming apparent. Of the two, AR3906 looks the more complex, with a weak delta region becoming apparent north of the main leading spot. AR3905 is starting to show more weak intermediate spots. The remaining spots on the disc are generally relatively smaller and simpler, although both AR3901 and AR3907 show some minor magnetic complexity, both having beta-gamma classifications.

All major flare risk regions remain on the disk through the forecast period, with far-side sounding data and recurrence suggesting the likelihood of further regions rotating on. A bright area on the northeast limb in SDO AIA imagery suggests there may be more to follow AR3908.

Overall solar activity is expected to be Low to Moderate, with occasional M-flares likely and a slight chance of isolated X-class flares, primarily from from the regions in the southeast. Risk is maintained steady through the period pending further developments and assessment of oncoming regions.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

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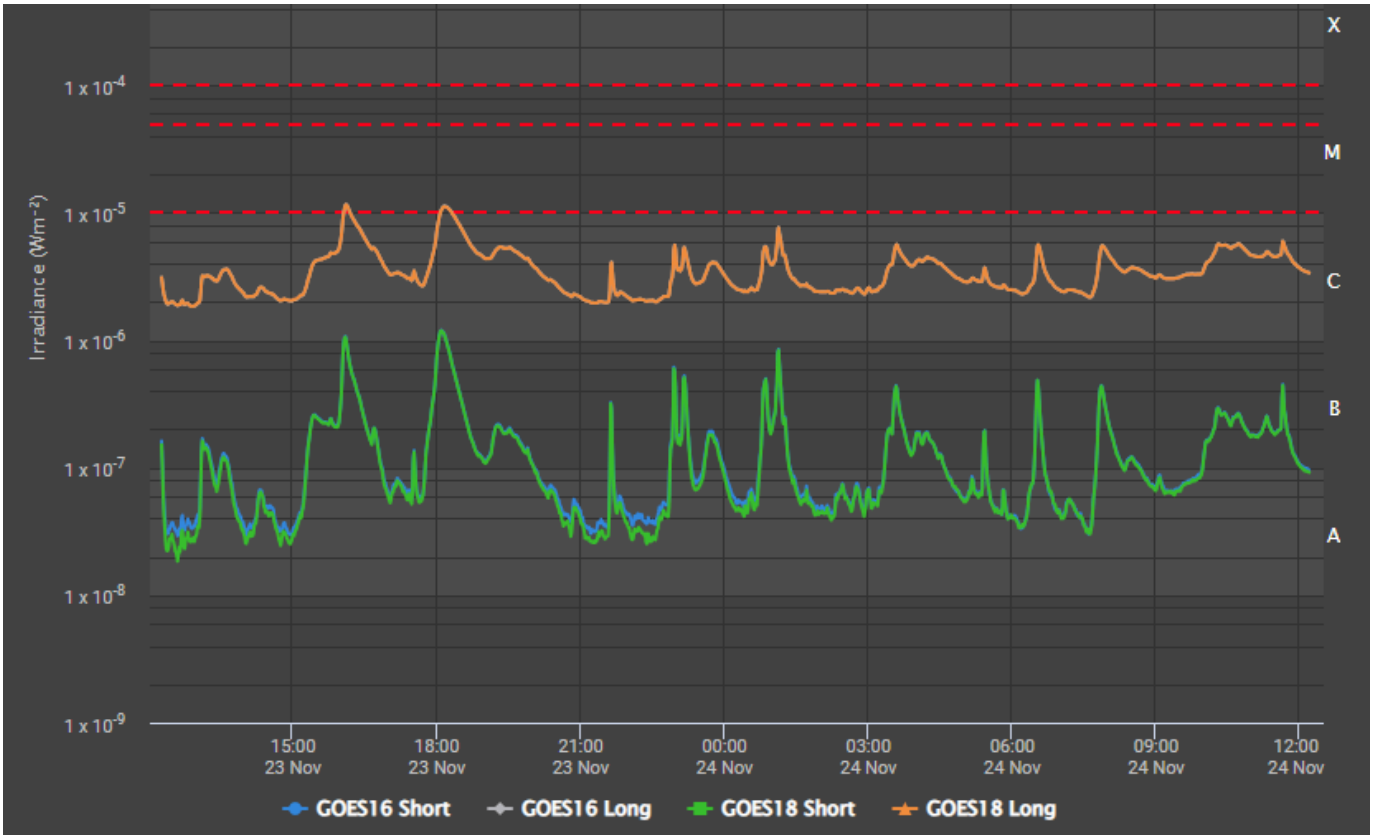
Figure 4: X-ray flux at GOES16 and 18.



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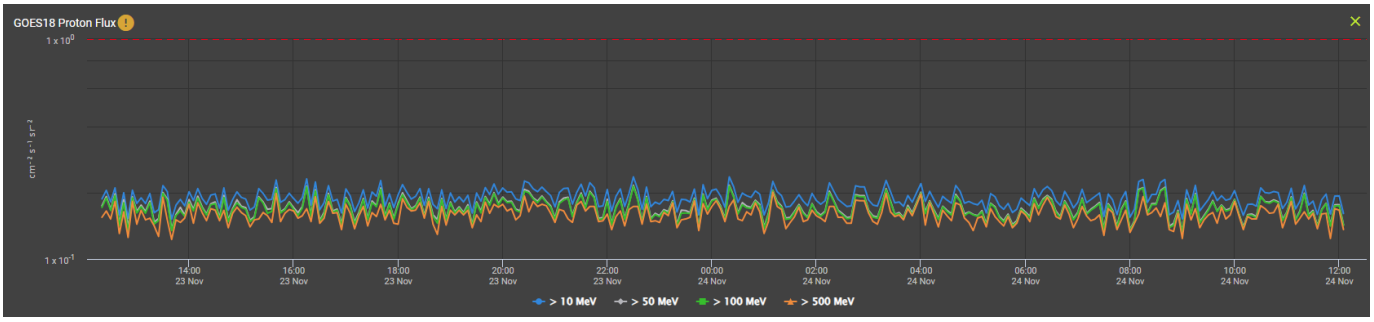
Solar Radiation Storms (High Energy Protons)

The recent enhancement to the GOES-18 Proton flux has now declined to background levels. This enhancement occurred due to a large eruption from over the west limb on 21 Nov, and was a relatively hard event with responses also observed in higher energy channels, including >100 MeV and >500 MeV. The likely source region, while impossible to observe and assess if it survived this event, is now thought to be well over the west limb and is increasingly unlikely to influence Earth if it should produce further large eruptions.

The main regions currently on the visible disc which are most likely to produce proton enhancements are AR3905 and AR3906 in the southeast quadrant. From this position any proton enhancements are less likely to affect Earth, but as they rotate towards centre disc the risk increases a little. The observed proton flux is subsequently expected to persist at background levels with a slight but rising chance of further enhancement into the period as AR3905 and AR3906 start to reach a more favourable position.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: Proton flux observed at GOES18.



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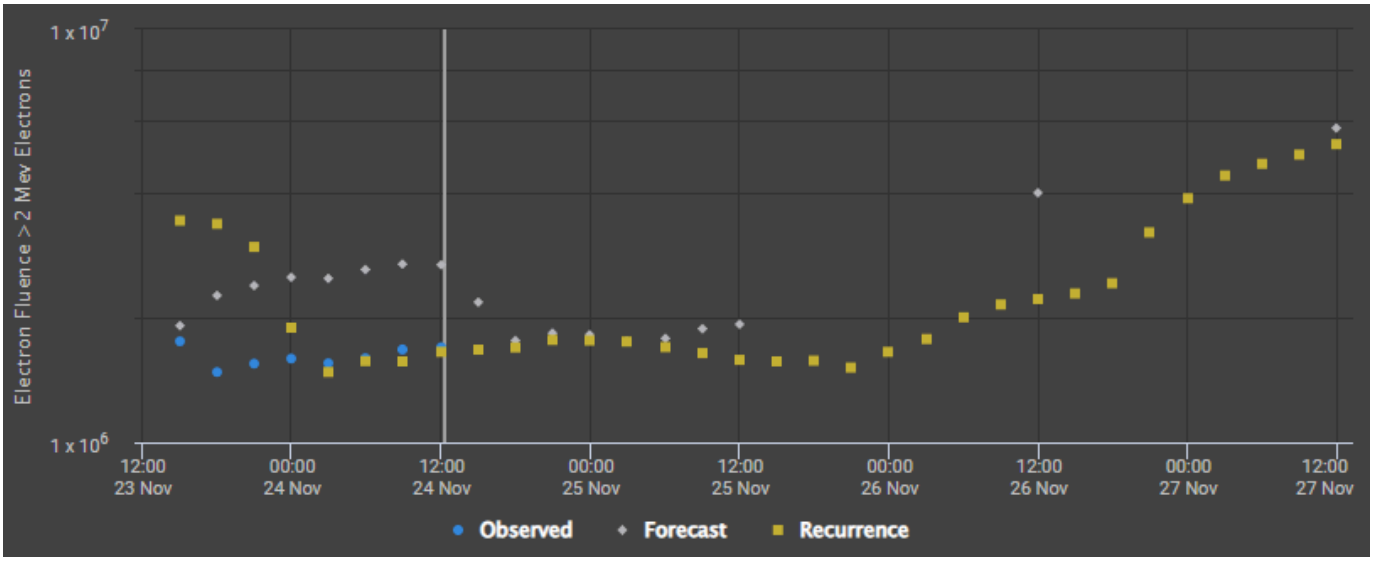
High Energy Electrons (≥ 2MeV)

Electron flux observed by GOES-16 has been at background levels and is expected to persist at this level, but with a chance of diurnal increases to moderate levels if we should see any fast wind enhancement to elevated levels in the next day or two.

The associated 24 hour fluence is expected to persist below the Active level but perhaps with a slight rising trend, with MOSWOC REFM output thought to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 6: MOSWOC REFM, which is thought to be providing good guidance at present.



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